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ESA PREPARES FOR GIOVE-B SATELLITE LAUNCH
UPI, April 24, 2008

PARIS-- The European Space Agency says it will provide live streaming video coverage of this weekend's launch of its GIOVE-B satellite, the second Galileo satellite. GIOVE-B -- Galileo In Orbit Validation Element -- is **scheduled for launch at 6:16 p.m. EDT Saturday** from the Baikonur Cosmodrome in Kazakhstan.

GIOVE-B was built by a European industrial team as a follow on project to the highly successful GIOVE-A -- both ESA experimental navigation satellites used in development of Europe's Galileo Positioning System. In addition to its technology-demonstration mission, the ESA said GIOVE-B will take over GIOVE-A's mission to secure the Galileo frequencies. GIOVE-A, launched in December 2005, is now approaching the end of its operational life.

USAF AWARDS RAYTHEON $61 MILLION FOR GLOBAL POSITIONING RECEIVERS
Globalnet News, 23 April 2008

El Segundo, CA -- Raytheon Company has won a $61 million U.S. Air Force contract to complete the development and certification of next-generation global positioning receivers. The contracting agency is the Global Positioning System Wing at the U.S. Air Force Space and Missile Systems Center, Los Angeles.

Under the Modernized User Equipment program, the circuit card technology will connect military users with new GPS navigation signals compatible with enhanced NAVSTAR GPS satellites. The receivers, which will employ the new M-code military signal, also will work effectively with legacy signal systems.

"The MUE program is raising the capability of military GPS equipment while lowering the cost for the warfighter," said Phil Kelton, MUE program manager for Raytheon's GPS and navigation systems business. "Raytheon's approach to MUE takes advantage of breakthroughs in microelectronics technology, coupled with advanced security solutions to enable higher performance and greater integrity at less cost than today's systems."

Kelton sees potential to achieve "true force-enhancing status" for military GPS capability though the proliferation of low-cost GPS modernized user equipment. Raytheon is teamed on the program with General Dynamics and Trimble Navigation Systems.

"The award of this second phase of the systems design and development contract allows us to complete the custom building-blocks being developed for the next-generation M-code GPS receivers," said Michael Crisp, director of Raytheon GPS and navigation systems. "This technology development will strengthen and preserve the secure GPS navigation capability in the equipment used by the U.S. and its allies in all missions." In addition, Crisp said, two form factor receiver cards are being developed that will allow modular upgrades of Raytheon's avionics, weapons and integrated sensor systems ahead of the full deployment of the GPS III satellite constellation.

EU PARLIAMENT APPROVES GALILEO NAVIGATION SYSTEM

NYTimes, 24 April 2008

The European Parliament gave its assent to the creation of the Galileo satellite navigation system Wednesday, clearing the way for the European Union's most ambitious technology project to date. Approval by the Parliament was the final political hurdle for the system, which only a year ago faced being abandoned after a consortium of private technology firms backed out.

The European Commission salvaged the project by proposing to take the deployment phase due for completion in 2013 public, a move that will cost European tax payers €3.4 billion (US$5.1 billion). A majority of the Parliament from across the political spectrum, however, concluded that Galileo is in E.U. citizens' interests.

"This will be the first infrastructure in Europe that is commonly built and jointly owned," said member of the European Parliament Etelka Barsi-Pataky. "During the political discussions on Galileo, the European Parliament has always strongly suggested that this strategic project should be managed as a political priority."

The Parliament's support for the new shape of the Galileo project will allow private firms to help fund the exploitation phase after 2013. They will be called on to help build the system as contractors, rather than as joint owners as initially planned.

GALILEO GETS €€ BAILOUT; NO INITIAL PROFITS PROJECTED

Bloomberg News, 24 April 2008

STRASBOURG-- The European Union on Wednesday ratified a €2.4 billion public bailout of the European satellite project meant to rival the GPS system in the United States.

The European Parliament endorsed new rules underlying a plan to tap the EU budget for the extra $3.8 billion to build the Galileo road, rail, ship and air-traffic control network. The approval removes the final hurdle after EU governments decided in November to use taxpayers' money to rescue the project, which is over budget and behind schedule.

"We are giving the go-ahead to one of the most important projects in the EU," Angelika Niebler of Germany, head of the Parliament's Industry Committee, told the assembly here. "This is a technology that we need."

The € 4.5 billion satellite program, one of the biggest European projects since Airbus in the 1970s, had been on the verge of collapse after companies, led by European Aeronautic Defense & Space and Alcatel-Lucent, balked at sharing the costs. The businesses cited the risks tied to launching and operating the system.

Governments had already pledged €1.5 billion to cover the entire initial "development" phase of Galileo and earmarked another € 600 million for part of the costs of launching the satellite. The EU had expected industry to meet most of the remaining expenses, saying the growth of commercial satellite markets would make the venture profitable.

Profitability was not guaranteed because the government-financed U.S. global positioning system, known as GPS and designed primarily for defense, is used for free by businesses worldwide. The EU's planned 30-satellite system would not become operational before 2013, five years later than originally foreseen.

A second experimental satellite for Galileo is due to be launched Sunday from Kazakhstan to test technologies, including atomic clocks, and to act as a backup for reserving radio frequencies. The first experimental satellite went up in December 2005 to reserve frequencies and evaluate technologies. Potential users of Galileo include airlines and logistics companies, but they have expressed doubts about the need for a European system to vie with GPS. EU politicians counter that Galileo would have better signals than GPS and offer a service guarantee, unlike the U.S. network, which can be cut off anytime for national security reasons.

"The project will help new technologies, entrepreneurship and jobs," said Etelka Barsi-Pataky, a Hungarian member of Parliament who steered the rescue accord through the assembly. Agreement among the EU's national governments was held up because Germany wanted national budgets to contribute, which would have increased the influence of individual governments. The German government changed its position, which was at odds with that of other countries, including France, after the commission outlined plans meant to prevent industrial work from being too concentrated in one country.

ATOMIC RHYTHMS GIVE PRECISE FIX
BBC News, April 24, 2008

In the late 18th Century, Captain Cook set out on a voyage of discovery clutching a pocket watch to help him keep track of his location.
The timepiece, which he described as "our faithful guide", was accurate to a couple of seconds per month, and helped fix the position of his ship to a distance of two nautical miles.

Two hundred years later, the general principle of using clocks to aid navigation still stands. But the latest generation of timepiece, to be launched into space onboard the Giove-B satellite, is a world away from Captain Cook's. "Such a clock has never been flown," Pierre Waller, an engineer at the European Space Agency (Esa), told BBC News.
The beating heart of Giove-B, the second test spacecraft for Europe's Galileo global satellite-navigation system, is a hydrogen maser atomic clock. Following its launch from the Baikonaur Cosmodrome in Kazakhstan, it will become the most precise time piece to orbit the Earth. It will be accurate to one billionth of a second per day, or one second in three million years. On board

By comparison, a typical wristwatch is accurate to about one second per day. This precision is needed, say the scientists who built the system, because even tiny errors can cause sat-nav handsets to be way out. A slip of just one second, for example, would produce location inaccuracies of around 300,000 km, approaching the distance from the Earth to the Moon.
If the technology is shown to be successful, it will be built into all 30 of Galileo's operational satellites, eventually allowing users to pinpoint their location with an error of just one metre, compared to the several metres experienced with current GPS technology.

"Everything has been verified on the ground - on paper - but now we want to verify and validate all of these assumptions on board," said Mr Waller. "For me, this is really the challenge of Giove-B."

The principles of satellite-navigation are well understood. Clocks are the core of all systems and are used to generate a time code which is continuously transmitted from the satellites."When you pick up that signal on the ground you can look at the time code [which] tells you when the satellite sent it out," explained Dr Peter Whibberley, of the National Physical Laboratory (NPL) in the UK.

Giove-B contains one hydrogen and two rubidium atomic clocks. "If you measure its time of arrival against the clock in your receiver, you know how long that signal took to get to you." This allows the distance from receiver to satellite to be calculated. "If you have three satellites in view, you can triangulate yourself on the surface of the Earth," explained Dr Whibberley. A fourth satellite allows a precise fix. "This whole process relies on satellites sending out very precisely timed signals."

The more accurate the time signal, the more accurate the fix. And currently, the most accurate timepieces are atomic clocks. Like conventional chronometers, these use a physical constant to measure the passing of time. But instead of the regular tick-tock of a pendulum, they use atoms switching between different energy states.

When an atom flips between a high and low energy state, it releases energy at a very precise frequency. Measuring this change and using it as an input into a counter produces an accurate measure of time. The main clock onboard Giove-B uses hydrogen as an atomic source. This emits microwave radiation which is used as an input to "calibrate" a quartz crystal, similar to those found in a regular wristwatch.

"A clock is a generator of a periodic signal," said Mr Waller. "Our periodic signal here is generated by quartz and we are using the [hydrogen] atoms to lock this quartz."

Relative times

Although the resulting time signal is accurate to within one nanosecond a day, the fact that the satellite is orbiting the Earth at a height of 23,222km (14,430 miles), means the signal must be tweaked before it is relayed. "On board Galileo - as with GPS - we have to take into account two different relativistic effects," said Mr Waller.

In particular, algorithms must factor aspects of Einstein's General and Special Theories of Relativity. For example, the so-called "relativistic Doppler effect", outlined in the Special Theory, shows that time is perceived differently by observers in different states of motion.

"A clock moving perpendicular to your line of sight will have a different tick rate to one at your location," explained Mr Waller. In addition, the Galileo system must account for what are known as "gravitational frequency shifts", outlined in the General Theory. "The tick rate of your clock is not the same on Earth and at 23,000km," said Mr Waller.

There will eventually be 30 satellites in the Galileo constellation "The stability of the active maser is roughly one order of magnitude better," explained Mr Waller. "But as a result the active maser is roughly five to 10 times heavier and bulkier." With weight and space at a premium onboard Giove-B, active maser technology was not an option. In addition, the craft must pack two more atomic clocks into its chassis. These back-up atomic chronometers use rubidium and are accurate to 10 nanoseconds per day.

One will be permanently running as a "hot" backup for the hydrogen maser, instantly taking over should it fail. The second rubidium clock will act as a so-called "cold" spare. The final Galileo satellites will contain four clocks - two hydrogen masers and two which use rubidium. This combination should ensure that the constellation, set to be up and running by the end of 2013, will offer uninterrupted and unparalleled accuracy on the ground.

In addition, it should improve the precision time services that have become so critical to economic activity, such as time-stamping of financial transactions and co-ordinating e-mail systems.

But soon even these clocks may be consigned to history alongside Captain Cook's pocket watch. Scientists at NPL are currently working on next-generation optical clocks, which use the frequency of light to help measure the passage of time. "The basic principle is the same as the current generation of clocks," explained Dr Whibberley. However, using light allows a more stable clock to be built.

"They could be placed on satellites to give much more precise time keeping, and that promises even greater performance in positioning," he said "They could potentially be one hundred times more accurate."

Satellite-navigation systems determine a position by measuring the distances to a number of known locations - the spacecraft constellation in orbit In practice, a sat-nav receiver will capture atomic-clock time signals sent from the satellites and convert them into the respective distances

A sat-nav device will use the data sent from at least four satellites to get the very best estimate of its position - whether on the ground or in the sky The whole system is monitored from the ground to ensure satellite clocks do not drift and give out timings that might mislead the user